



## Shaping our Energy Future with Electrospinning

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**School of Chemical Engineering  
Research Seminar on**

**Shaping our Energy Future with Electrospinning**

**2 Dec 2013 (Mon)**

**3-4:00pm**

By

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Technical University of Denmark**

**N218, Engineering North Building  
The University of Adelaide**

Electrochemical devices for clean energy conversion such as proton exchange membrane fuel cells<sup>1-3</sup> and solid oxide fuel cells<sup>4-5</sup> are currently and for the foreseeable future very much in the spotlight. Although these developing energy technologies have seen a rapid development, new break-through developments are needed to improve their durability, efficiency, power density and cost to make them commercial viable. Among those energy-related devices, functional ion-conductive membranes and electrodes play crucial roles in determining electrochemical reaction rate, system degradation and integration, which depend intimately on the properties of their materials.

Nanostructured materials are becoming increasingly important for electrochemical conversion and storage devices in recent years because of the unusual mechanical, electrical and optical properties endowed by confining the dimensions of such materials and because of the combination of bulk and surface properties to the overall behavior. The greatest advantage of electrospinning is the possibility of generating composite networks from a rich variety of materials with the ability to control composition, morphology and secondary structure which allows design of optimum material characteristics for membranes. This simple and versatile method has been used in my research to address the sizable challenges facing those involved in materials research into energy conversion devices.

Herein, initial results will be presented on 1) electrolyte/catalysts composite electrodes for proton exchange membrane fuel cells; 2) Ceramic nanofiber cathode for solid oxide fuel cells. Enhancements in electrochemical performance, mechanical properties and durability were clearly seen and related to the unique three-dimensional network of nanofibers, which enhances gas accessibility, optimizes three-phase boundary and improves water management on the cathode side. The outcomes of these inventions are significant reduction in precious metal catalyst loading and improvement of durability of fuel cells without sacrificing electrochemical performance. This brings fuel cell technology one step forward towards green energy in real life.

[1] Christie, A. M.; Lilley, S. J.; Staunton, E.; Andreev, Y. G.; Bruce, P. G. Increasing the conductivity of crystalline polymer electrolytes, *Nature* (2005) 433: 50-53. [2] Gasteiger, H. A.; Kocha, S. S.; Sompalli, B.; Wagner, F. T. Activity benchmarks and requirements for Pt, Pt-alloy, and non-Pt oxygen reduction catalysts for PEMFCs, *Appl Catal B-Environ* (2005) 56: 9-35. [3] Litster, S.; McLean, G. [PEM fuel cell electrodes](#), *J Power Sources* (2004) 130: 61-76. [4] Eric D. Wachsman, Kang Taek Lee, Lowering the Temperature of Solid Oxide Fuel Cells, *Science* (2011) 334: 935-939. [5] Brian C. H. Steele, Angelika Heinzl, Materials for fuel-cell technologies, *Nature* (2001) 414: 345-352

Ambitious Scientist and Hans Christian Ørsted Fellow with background in materials science and energy technology with excellent academic track record. Graduated from Asian No.1 University with 3 years postdoc experience in top ranked US university's research group on fuel cell technology. Collaborated on research projects with renowned global companies (e.g., Nissan North America, 3M Corporation and Merck-Millipore), in the field of nanotechnology, electrochemistry and material engineering. Substantial experience in conducting independent award winning research, mentoring PhD and undergraduate students, writing successful government subsidy proposals (US Department of Energy and Technical University of Denmark), published research papers and US patent. Breakthrough invention in the nanofiber electrode patent attracts buyers from industry (Merck-Millipore and Nissan Co.).